

**AMENDMENTS TO THE CLAIMS:**

This listing of claims will replace all prior versions, and listings, of claims in the application.

1 - 15. (Cancelled)

16. (Currently Amended) The semiconductor optoelectronic waveguide according to claim ~~[[15]]~~ 50, ~~wherein~~ further comprising a ~~[[first]]~~ second set of semiconductor ~~elad layer is~~ layers having an upper layer arranged between said first layer and set core layer and a lower layer arranged between said ~~each of one main surface and the other main surface of the semiconductor core layer and [[the]] said second semiconductor ~~elad layer, wherein~~ [[a]] band [[gap]] gaps of said second set of semiconductor the first semiconductor layers are ~~elad layer is~~ greater than that of the band gap of said semiconductor core layer, and [[each]] band [[gap]] gaps of said first set of the second semiconductor layers are ~~elad layer and the third semiconductor ~~elad layer is~~ greater than the band [[gap]] gaps of the ~~[[first]] second set of semiconductor layers~~ ~~elad layer.~~~~~~

17. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 16, wherein ~~[[the]]~~ an impurity concentration of said pn junction layer is controlled established for the thickness of each layer and the impurity concentration in such a way that under an operating state of the semiconductor optoelectronic waveguide, the [[p]] p-type layer is depleted in a whole range while the [[n]] n-type layer is at least partially depleted.

18. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 17, wherein the impurity concentration is  $1 \times 10^{17} \text{ cm}^{-3}$  or greater for the ~~[[p]] p-type layer of the pn junction layer~~ and  $5 \times 10^{17} \text{ cm}^{-3}$  or greater for the ~~[[n]] n-type layer~~.

19. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 16, wherein the impurity concentration is  $1 \times 10^{17} \text{ cm}^{-3}$  or greater for the ~~[[p]] p-type layer of the pn junction layer~~ and  $5 \times 10^{17} \text{ cm}^{-3}$  or greater for the ~~[[n]] n-type layer~~.

20. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 16, wherein an impurity forming a deep level is doped on the ~~[[n]] n-type layer of the pn junction layer, in addition to an n-type impurity.~~

21. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 20, wherein a band gap energy of the ~~[[n]] n-type layer of the pn junction layer~~ is smaller than that a band gap energy of the ~~p-layer of the pn junction~~ p-type layer.

22. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 20, wherein the impurity having a deep level and doped on the ~~n-layer n-type of the pn junction layer~~ is Fe.

23. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 16, wherein a band gap energy of the ~~[[n]] n-type layer of the pn junction layer~~ is

smaller than that a band gap energy of the ~~p-layer of the pn-junction~~ p-type layer.

24. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 23, wherein ~~[[the]]~~ an Fe impurity having a deep level ~~[[and]]~~ is doped on the ~~n-layer~~ n-type of the ~~pn-junction~~ layer is Fe.

25. (Currently Amended) The semiconductor optoelectronic waveguide according to claim ~~[[15]]~~ 50, wherein ~~[[the]]~~ an impurity concentration of said pn junction layer is controlled ~~established for the thickness of each layer and the impurity concentration in~~ such a way that under an operating state of the semiconductor optoelectronic waveguide, the ~~[[p]]~~ p-type layer is depleted in a whole range while the ~~[[n]]~~ n-type layer is at least partially depleted.

26. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 25, wherein the impurity concentration is  $1 \times 10^{17} \text{ cm}^{-3}$  or greater for the ~~[[p]]~~ p-type layer ~~of the pn-junction layer~~ and  $5 \times 10^{17} \text{ cm}^{-3}$  or greater for the ~~[[n]]~~ n-type layer.

27. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 25, wherein an impurity forming a deep level is doped on the ~~[[n]]~~ n-type layer ~~of the pn-junction layer, in addition to an n-type impurity.~~

28. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 25, wherein a band gap energy of the ~~[[n]]~~ n-type layer ~~of the pn-junction layer~~ is

smaller than that a band gap energy of the ~~p-layer of the pn-junction~~ p-type layer.

29. (Currently Amended) The semiconductor optoelectronic waveguide according to claim ~~[[15]]~~ 50, wherein ~~[[the]]~~ an impurity concentration of the p-type layer is  $1 \times 10^{17}$   $\text{cm}^{-3}$  or greater ~~for the p-layer of the pn-junction layer~~ and an impurity concentration of the n-type layer is  $5 \times 10^{17} \text{ cm}^{-3}$  or greater ~~for the n-layer~~.

30. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 29, wherein an impurity forming a deep level is doped on the ~~[[n]]~~ n-type layer ~~of the pn-junction layer, in addition to an n-type impurity~~.

31. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 29, wherein a band gap energy of the ~~[[n]]~~ n-type layer ~~of the pn-junction layer~~ is smaller than that a band gap energy of the ~~p-layer of the pn-junction~~ p-type layer.

32. (Currently Amended) The semiconductor optoelectronic waveguide according to claim ~~[[15]]~~ 50, wherein an impurity forming a deep level is doped on the ~~[[n]]~~ n-type layer ~~of the pn-junction layer, in addition to an n-type impurity~~.

33. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 32, wherein a band gap energy of the ~~[[n]]~~ n-type layer ~~of the pn-junction layer~~ is smaller than that a band gap energy of the ~~p-layer of the pn-junction~~ p-type layer.

34. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 33, wherein the impurity having ~~[[a]]~~ the deep level ~~and doped on the n-layer of the pn-junction-layer~~ is Fe.

35. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 32, wherein the impurity having ~~[[a]]~~ the deep level ~~and doped on the n-layer of the pn-junction-layer~~ is Fe.

36. (Currently Amended) The semiconductor optoelectronic waveguide according to claim ~~[[15]]~~ 50, wherein a band gap energy of the ~~[[n]]~~ n-type layer ~~of the pn-junction-layer~~ is smaller than that of the ~~p-layer~~ p-type layer ~~of the pn-junction-layer~~.

37. (Currently Amended) The semiconductor optoelectronic waveguide according to claim 36, wherein ~~[[the]]~~ an Fe impurity having a deep level ~~[[and]]~~ is doped on the n-type layer ~~n-layer of the pn-junction-layer~~ is Fe.

38. (Withdrawn) A semiconductor optoelectronic waveguide comprising;  
a semiconductor core layer having effective electro-optical effects;  
a first and a second semiconductor clad layers which vertically hold the semiconductor core layer and whose band gap is greater than that of the semiconductor core layer;  
a third and a fourth semiconductor clad layers which vertically hold the first and the second semiconductor clad layers and contain an n-type dopant;

a fifth semiconductor layer having the first and the third semiconductor clad layers on the substrate side, which is arranged between the first semiconductor clad layer and the third semiconductor clad layer, containing a p-type dopant and whose band gap is greater than that of the semiconductor core layer;

at least one electrical isolation region formed by implanting ions into the fourth semiconductor clad layer to improve the quality of materials; and

electrodes individually provided at a major region other than the electrical isolation region of the fourth semiconductor clad layer and at the third semiconductor clad layer,

wherein voltage is applied to the semiconductor core layer.

39. (Withdrawn) The semiconductor optoelectronic waveguide according to claim 38, wherein

the implanted ion species is an atom which forms an acceptor or a deep donor/acceptor pair level inside the fourth semiconductor clad layer.

40. (Withdrawn) The semiconductor optoelectronic waveguide according to claim 39, wherein the fourth semiconductor clad layer is provided with three or more electrical isolation regions.

41. (Withdrawn) The semiconductor optoelectronic waveguide according to claim 40, wherein an electrode is provided on the fourth semiconductor clad layer which is



opposed to a major region of the fourth semiconductor clad layer across the electrical isolation region, and connected to an electrode of the third semiconductor clad layer.

42. (Withdrawn) The semiconductor optoelectronic waveguide according to claim 39, wherein an electrode is provided on the fourth semiconductor clad layer which is opposed to a major region of the fourth semiconductor clad layer across the electrical isolation region, and connected to an electrode of the third semiconductor clad layer.

43. (Withdrawn) The semiconductor optoelectronic waveguide according to claim 38, wherein the fourth semiconductor clad layer is provided with three or more electrical isolation regions.

44. (Withdrawn) The semiconductor optoelectronic waveguide according to claim 43, wherein an electrode is provided on the fourth semiconductor clad layer which is opposed to a major region of the fourth semiconductor clad layer across the electrical isolation region, and connected to an electrode of the third semiconductor clad layer.

45. (Withdrawn) The semiconductor optoelectronic waveguide according to claim 38, wherein an electrode is provided on the fourth semiconductor clad layer which is opposed to a major region of the fourth semiconductor clad layer across the electrical isolation region, and connected to an electrode of the third semiconductor clad layer.

46. (Withdrawn) A semiconductor optoelectronic waveguide comprising;  
a semiconductor core layer having electro-optical effects;

a first and a second semiconductor clad layers which vertically hold the semiconductor core layer and whose band gap is greater than that of the semiconductor core layer;

a third semiconductor clad layer containing an n-type dopant which is arranged under the first semiconductor clad layer;

a fourth semiconductor clad layer which is arranged on the second semiconductor clad layer;

a fifth semiconductor layer in which the third semiconductor clad layer and the first semiconductor clad layer are arranged on the substrate side and a p-type dopant is contained between the second semiconductor clad layer and the fourth semiconductor clad layer and whose band gap is greater than that of the semiconductor core layer;

a major region of an n-type modulation waveguide formed inside a part of the fourth clad layer;

an isolation region adjacent to the major region, having a p-type electrical conductivity and in contact with an electrode common to the major region; and

another electrode provided on the third semiconductor clad layer,

wherein voltage is applied to the semiconductor core layer via both of the above-described electrodes.

47. (Withdrawn) The semiconductor optical modulation waveguide according to claim 46, wherein a part of the major region of the n-type modulator waveguide inside the fourth clad layer is given a region having a p-type electrical conductivity and the region



having the p-type electrical conductivity is provided with an electrode electrically common to the n-type major region.

48. (Withdrawn) The semiconductor optoelectronic waveguide according to claim 47, wherein a pair of electrodes are provided on the fourth clad layer on both outer sides of the major region of the n-type modulator waveguide and each of the electrodes is connected to an electrode of the third semiconductor clad layer.

49. (Withdrawn) The semiconductor optoelectronic waveguide according to claim 46, wherein a pair of electrodes are provided on the fourth clad layer on both outer sides of the major region of the n-type modulator waveguide and each of the electrodes is connected to an electrode of the third semiconductor clad layer.

50. (New) A semiconductor optoelectronic waveguide comprising:  
a set of n-type electrode layers having an upper n-type electrode layer and a lower n-type electrode layer;  
a semiconductor core layer arranged between said n-type electrode layers, the semiconductor core layer having electro-optical effects when a voltage is supplied between said n-type electrode layers, the electro-optical effects being used to modulate an optical signal;  
a first set of semiconductor layers having a first layer arranged between said upper n-type electrode layer and said core layer and a second layer arranged between said lower n-type electrode layer and said core layer; and

a pn junction including:

a p-type layer arranged between said upper n-type electrode layer  
and said first layer; and

an n-type layer arranged between said upper n-type electrode layer  
and said p-type layer.

51. (New) The semiconductor optoelectronic waveguide according to claim 50,  
wherein said p-type layer and said n-type layer are laminated together.